

Enhanced Hail Detection Algorithm

Briefing for the TAC

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Continued development of the Hail Detection Algorithm (HDA)

- ◆ Our efforts have been focused on improving the accuracy of the HDA's severe hail predictions
 - Probability of severe hail (POSH)
 - Maximum expected hail size (MEHS)

The WSR-88D HDA

- ◆ POSH depends on just one radar parameter (severe hail index; SHI) and one environmental parameter (melting level)
- ◆ MEHS depends on just SHI
- ◆ Simple prediction equations are used

The enhanced HDA

- ◆ Uses more radar parameters for both POSH and MEHS
 - Maximum reflectivity
 - Base reflectivity
 - Cell-based VIL
 - Severe hail index
 - Storm-top divergence
 - Midaltitude rotational velocity

The enhanced HDA

- ◆ Uses more environmental parameters for both POSH and MEHS
 - Melting level
 - Height of the -20° C level
 - Height of the wet-bulb zero
 - Vertically-integrated wet-bulb temperature
 - Wind speed at the equilibrium level (EL)
 - Storm-relative flow at the -20° C level

The enhanced HDA

- ◆ Neural networks are used to make predictions for both POSH and MEHS
- ◆ Development has involved methods to reduce the impacts of verification problems
 - Use a population density filter (for POSH)
 - Use only the largest reported hail size per storm (for MEHS)

The WSR-88D HDA

- ◆ Was developed using a relatively small data set, consisting of
 - 11 storm days from OK and FL
 - 55 severe hailstorms
 - 147 severe hail reports

The enhanced HDA

- ◆ Has been developed using a large and diverse data set, currently consisting of
 - 130 storm days
 - 550 severe hailstorms
 - 1346 severe hail reports

The Data Set

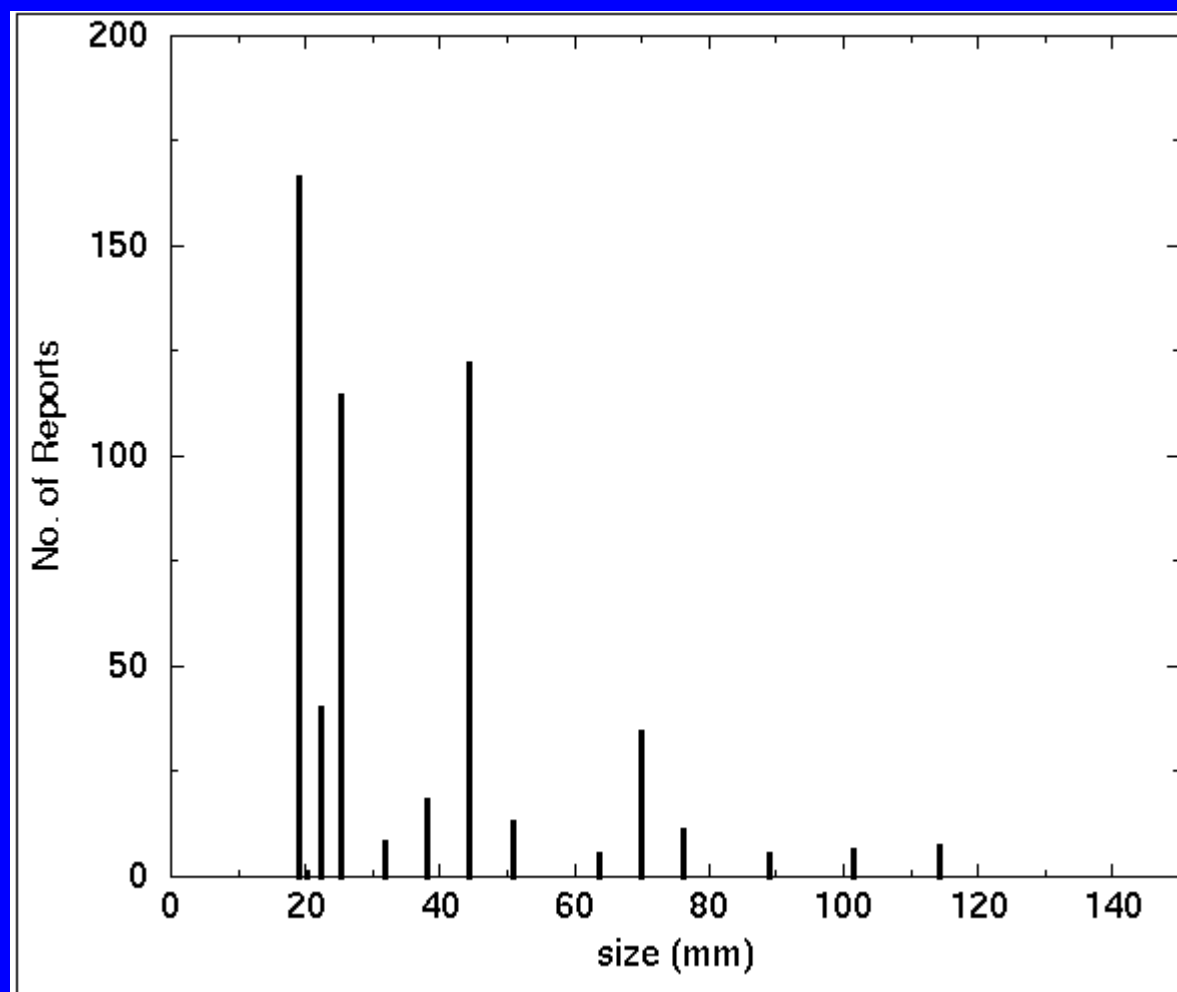
- ◆ Nationwide coverage from 67 RDA sites



The hail-size neural networks

- ◆ One neural network (NN) predicts the maximum expected hail size (MEHS)
- ◆ A second NN produces conditional probabilities for three different size categories
 - Coin-size hail (0.75 - 1.25 inch)
 - Golf ball-size hail (1.5 - 2.25 inches)
 - Baseball-size hail (≥ 2.5 inches)

The hail-size data

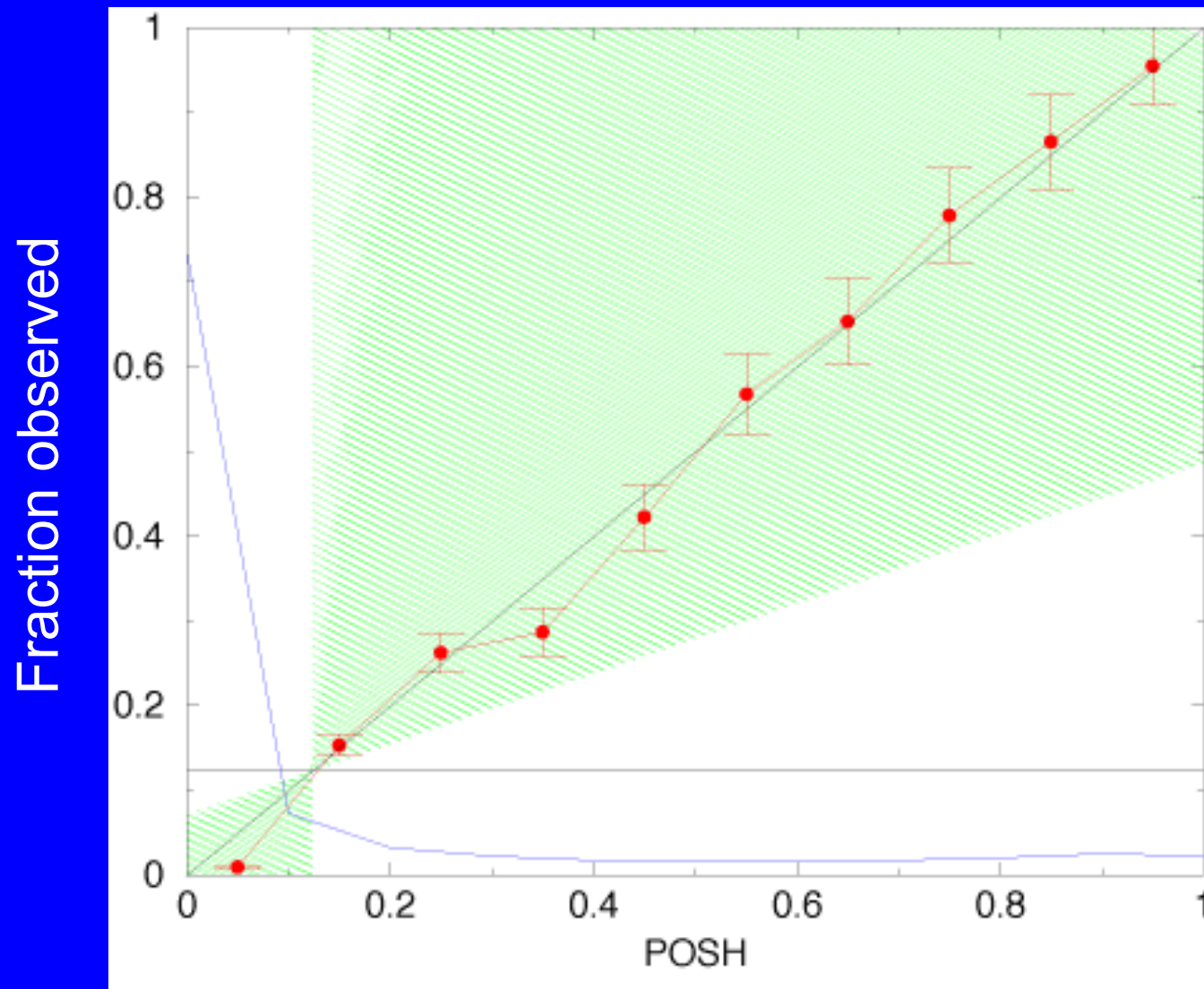


Performance results - POSH

	88D	EHDA
POD	.62	.68
FAR	.26	.22
CSI	.51	.57
HSS	.64	.70

Performance results - POSH

Reliability of the EHDA



Performance results - MEHS

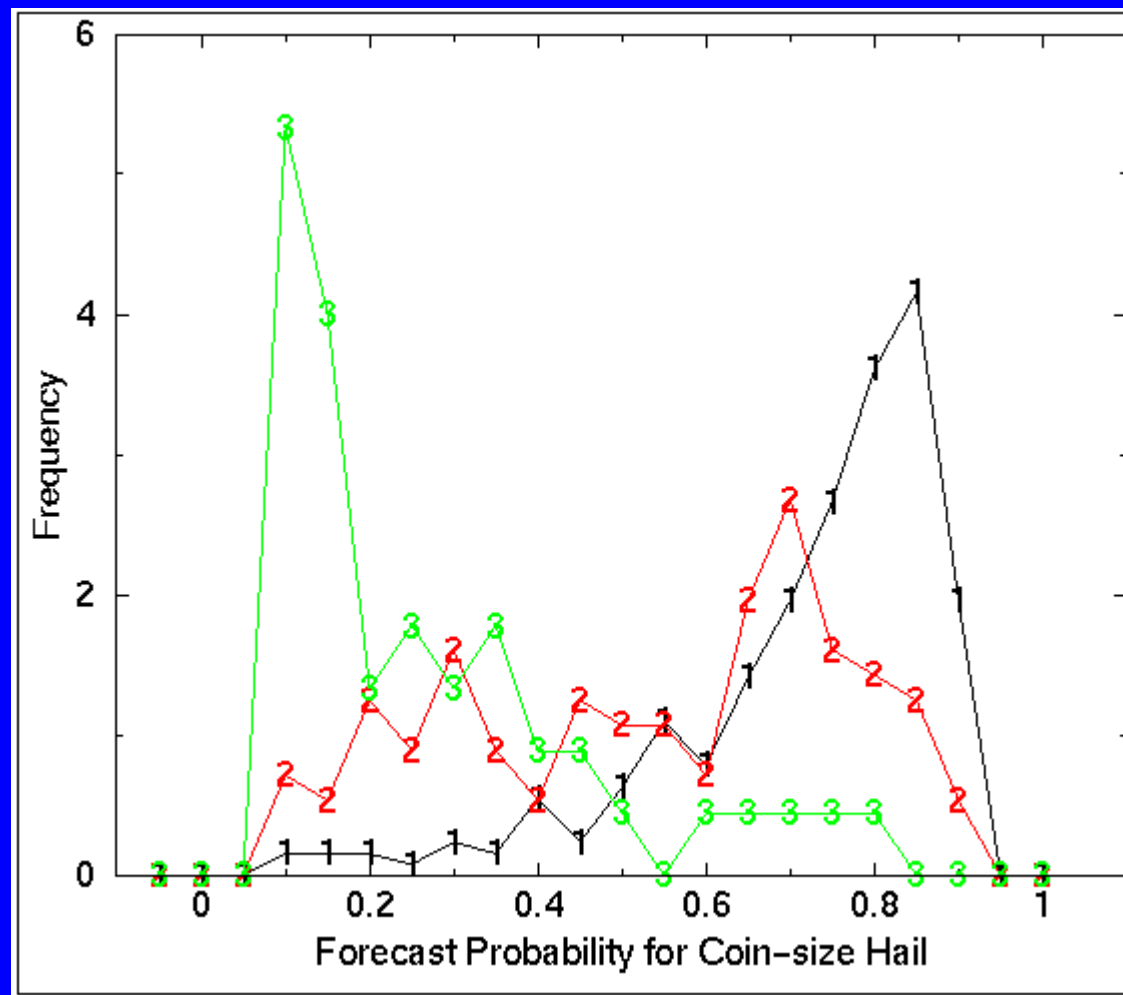
- ◆ Mean-square error for the MEHS predictions

● WSR-88D HDA	0.55
● Enhanced HDA	0.39

- ◆ Accuracy improved by 30%

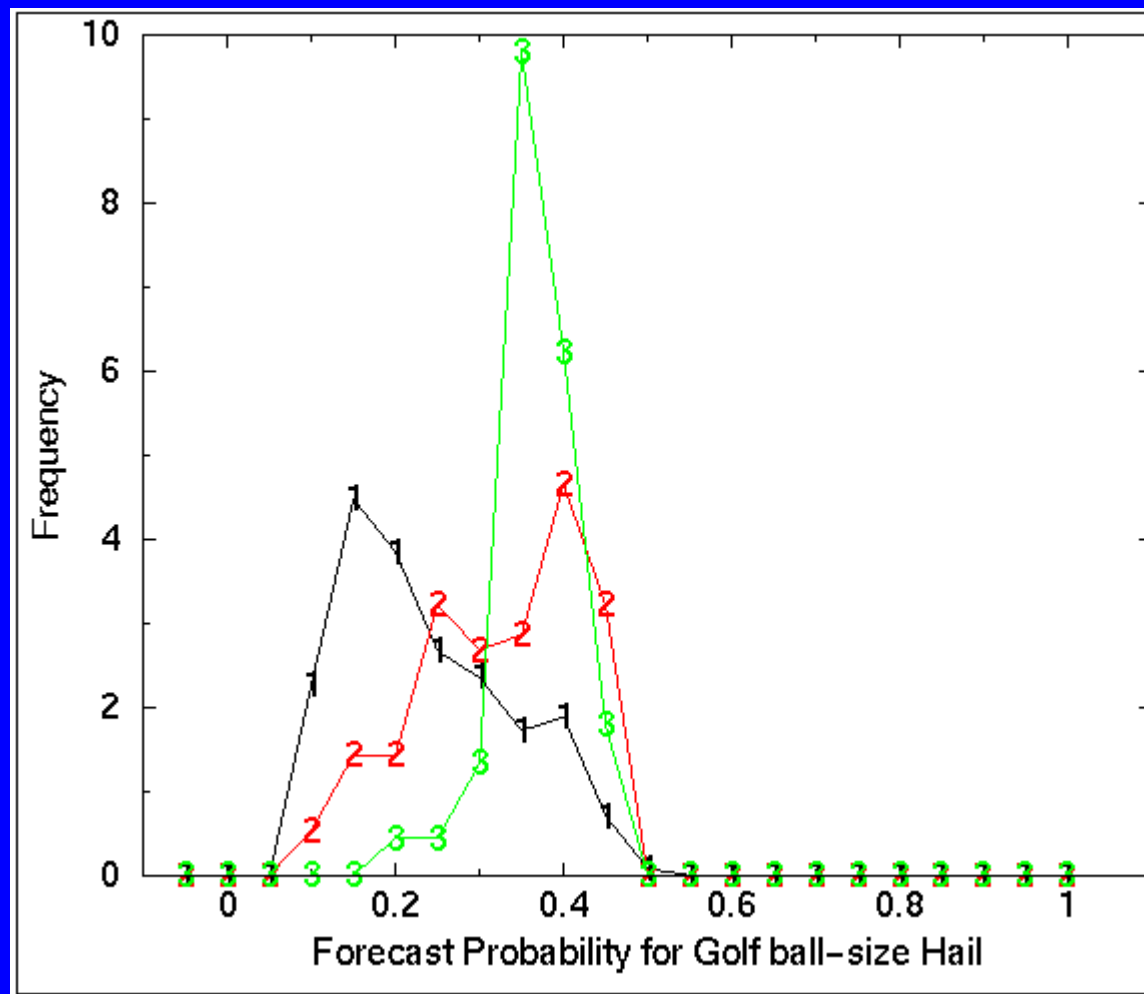
Hail size categories

Discrimination capability of the EHDA



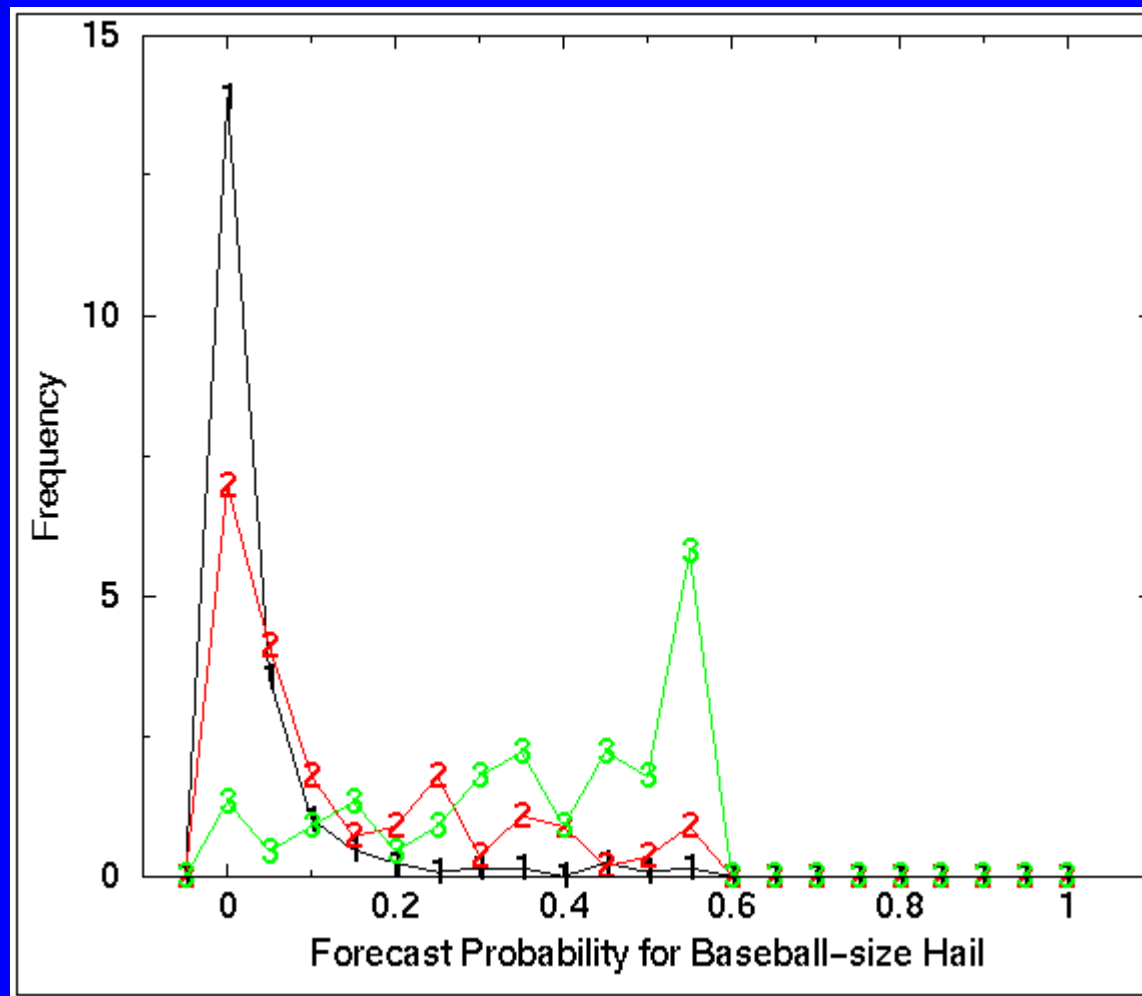
Hail size categories

Discrimination capability of the EHDA



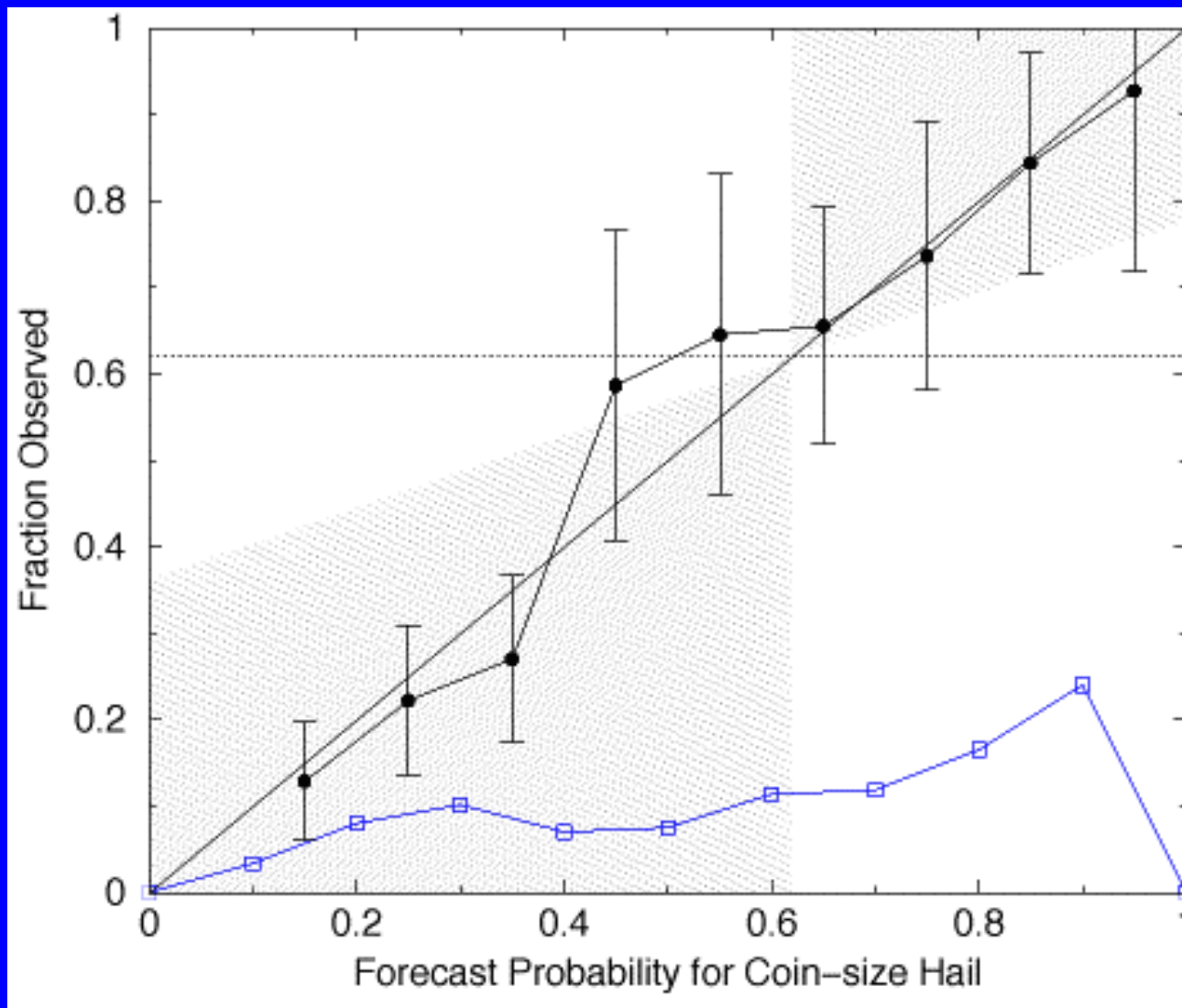
Hail size categories

Discrimination capability of the EHDA



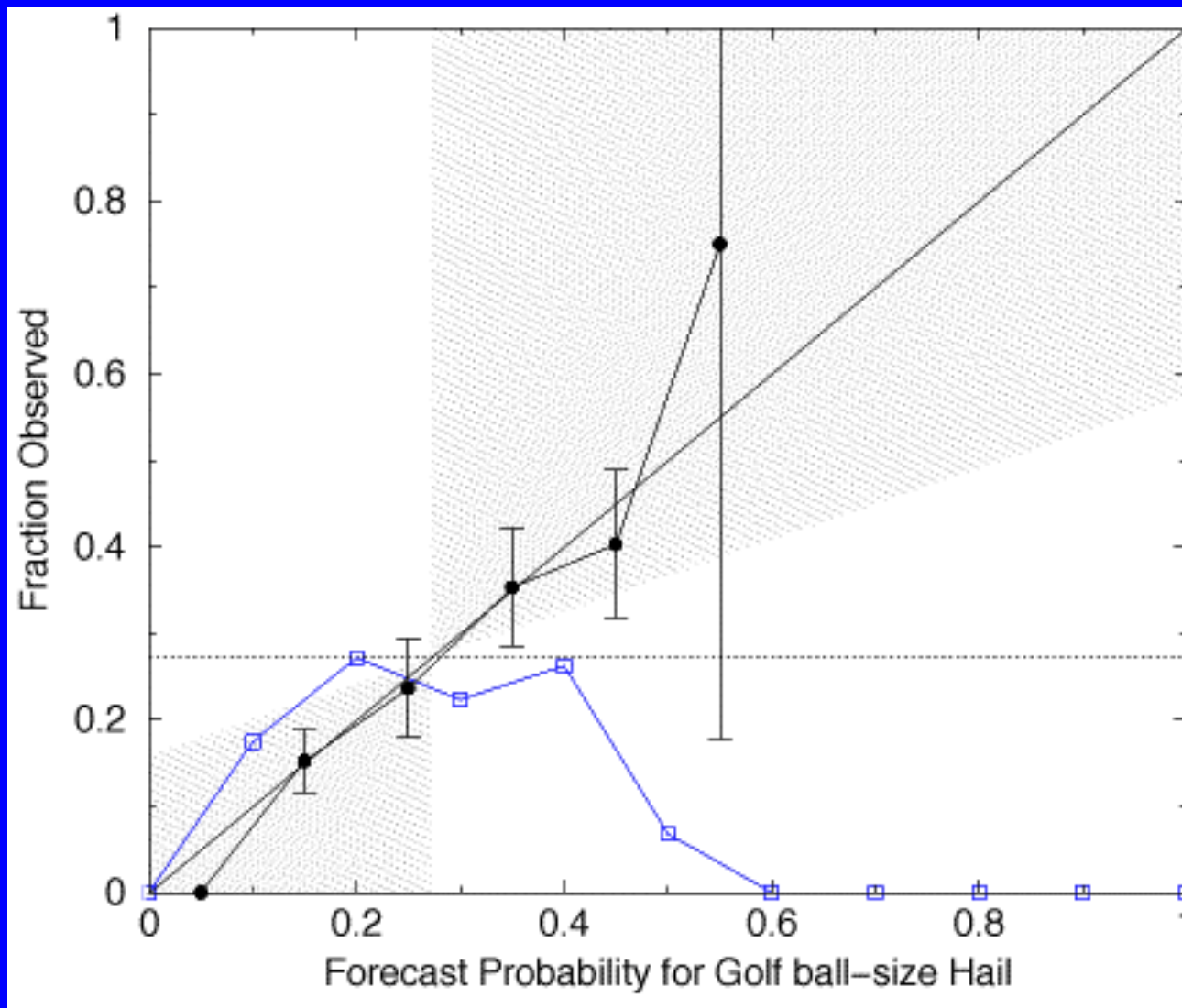
Hail size categories

Reliability of the EHDA



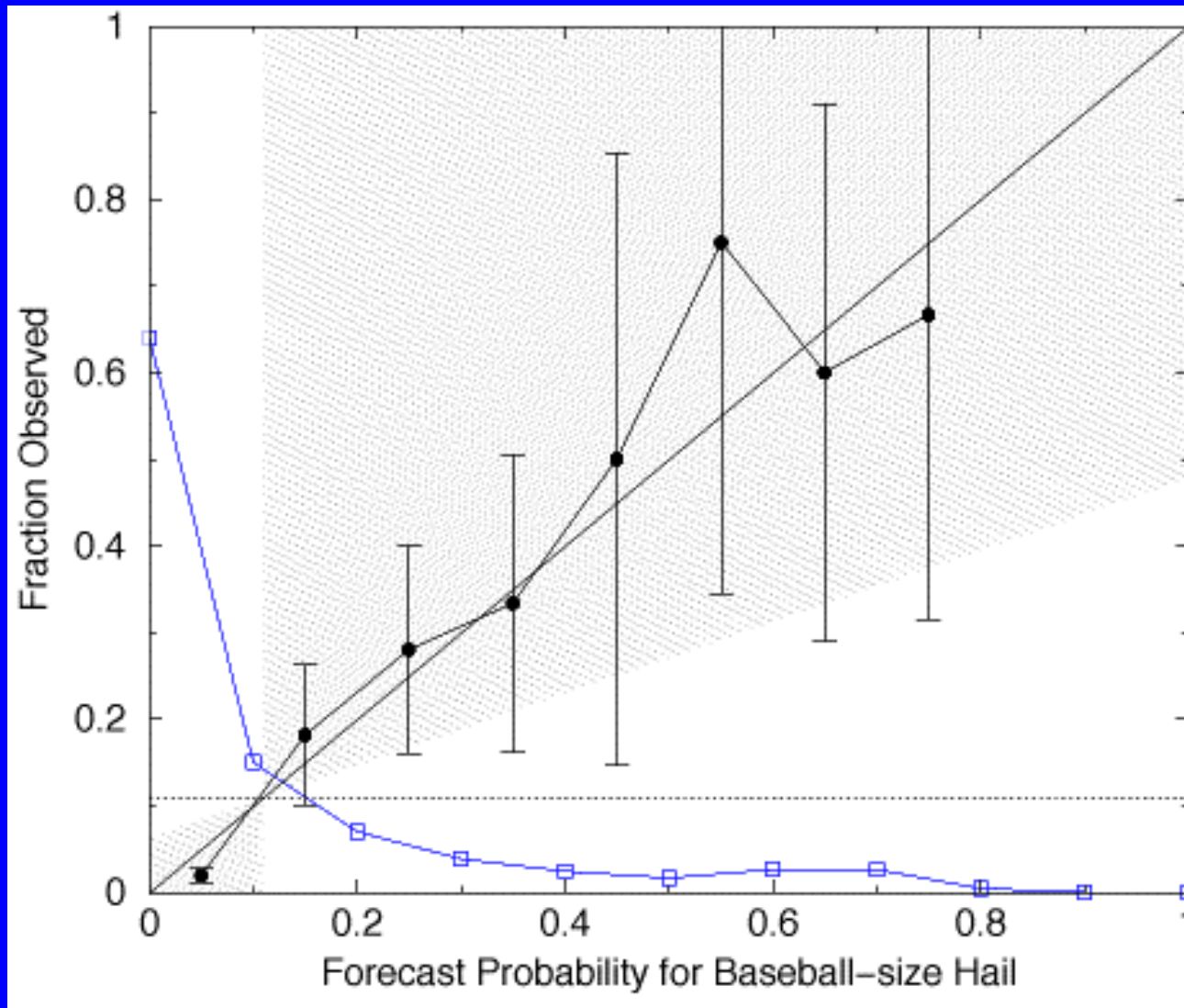
Hail size categories

Reliability of the EHDA



Hail size categories

Reliability of the EHDA



Status of the enhanced HDA

- ◆ It is part of NSSL's WDSS-II system
- ◆ It is available for implementation in the WSR-88D